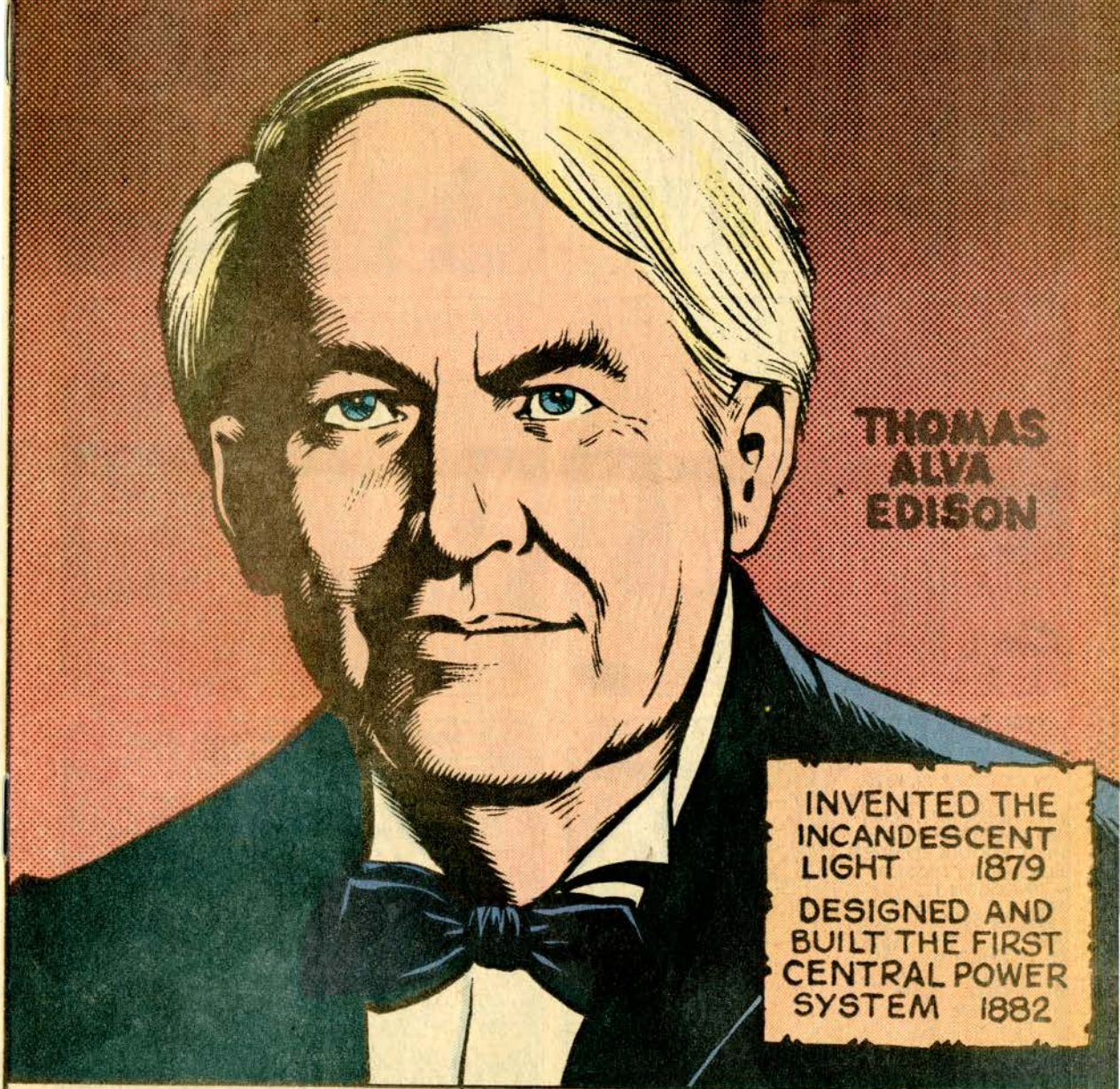
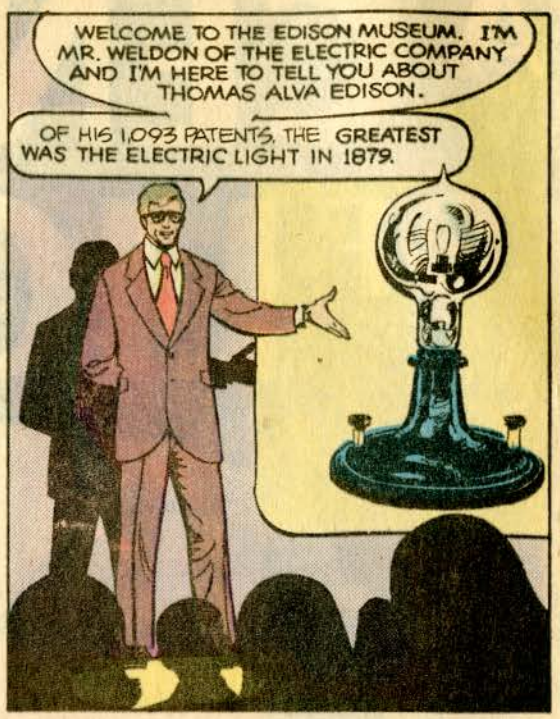
A CENTURY OF LIGHT



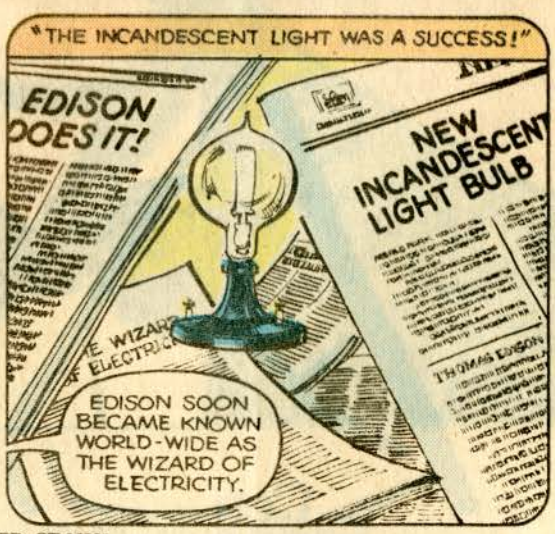
Con Edison conserve energy

Consumer Education
1625-S
4 Irving Place
New York, N.Y. 10003

IT'S A SHOW ABOUT EDISON. HE INVENTED ELECTRICITY.
IMAGINE WHAT IT WOULD BE LIKE WITH NO LIGHTS AT NIGHT!
EDISON MUSEUM
A CENTURY OF LIGHT
NO, EDISON DIDN'T INVENT ELECTRICITY. HE INVENTED THE LIGHT BULB.
A CENTURY OF LIGHT


WELCOME TO THE EDISON MUSEUM. I'M MR. WELDON OF THE ELECTRIC COMPANY AND I'M HERE TO TELL YOU ABOUT THOMAS ALVA EDISON.
OF HIS 1,093 PATENTS, THE GREATEST WAS THE ELECTRIC LIGHT IN 1879.

"FINALLY HE FOUND THE ANSWER... A FILAMENT MADE OF CARBONIZED THREAD."
ON OCTOBER 21, 1879, THE FILAMENT BECAME INCANDESCENT, GLOWING FROM THE WHITE HEAT PRODUCED WHEN ELECTRICITY PASSED THROUGH IT.
IT SHED GOOD LIGHT FOR OVER FORTY HOURS.
2


"THE INCANDESCENT LIGHT WAS A SUCCESS!"
EDISON DOES IT!
NEW INCANDESCENT LIGHT BULB
EDISON SOON BECAME KNOWN WORLD-WIDE AS THE WIZARD OF ELECTRICITY.

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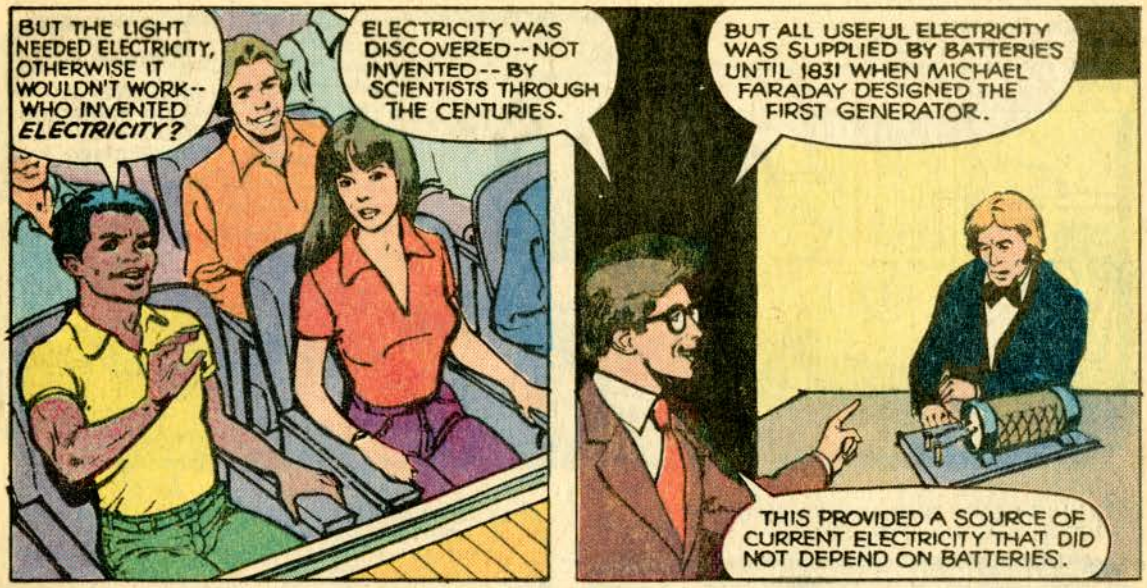
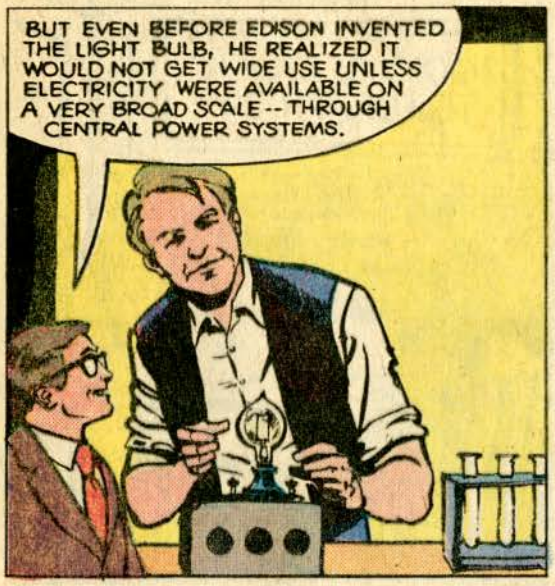
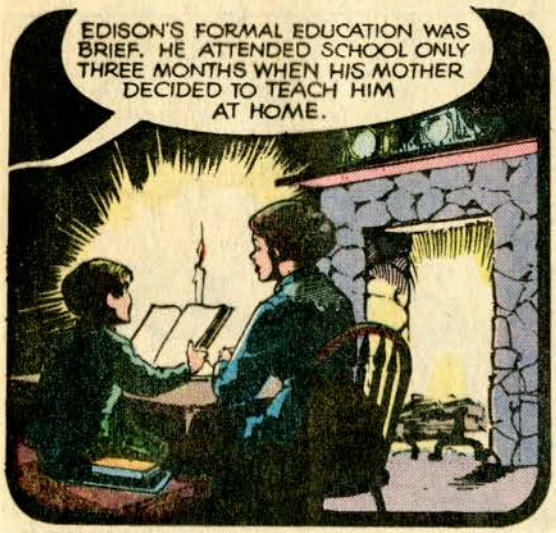

BUT THE LIGHT NEEDED ELECTRICITY, OTHERWISE IT WOULDN'T WORK-- WHO INVENTED *ELECTRICITY?*
ELECTRICITY WAS DISCOVERED--NOT INVENTED--BY SCIENTISTS THROUGH THE CENTURIES.
BUT ALL USEFUL ELECTRICITY WAS SUPPLIED BY BATTERIES UNTIL 1831 WHEN MICHAEL FARADAY DESIGNED THE FIRST GENERATOR.
THIS PROVIDED A SOURCE OF CURRENT ELECTRICITY THAT DID NOT DEPEND ON BATTERIES.


BUT EVEN BEFORE EDISON INVENTED THE LIGHT BULB, HE REALIZED IT WOULD NOT GET WIDE USE UNLESS ELECTRICITY WERE AVAILABLE ON A VERY BROAD SCALE--THROUGH CENTRAL POWER SYSTEMS.

"EDISON WAS BORN IN MILAN, OHIO, ON FEBRUARY 11, 1847, OF MIDDLE-CLASS PARENTS. HIS MOTHER HAD BEEN A TEACHER."

AS A BOY HE WAS VERY OBSERVANT AND CURIOUS. ONCE HE SAW A GOOSE SITTING ON EGGS AND HATCHING CHICKS. HE TRIED... BUT NO BABY GEESE!



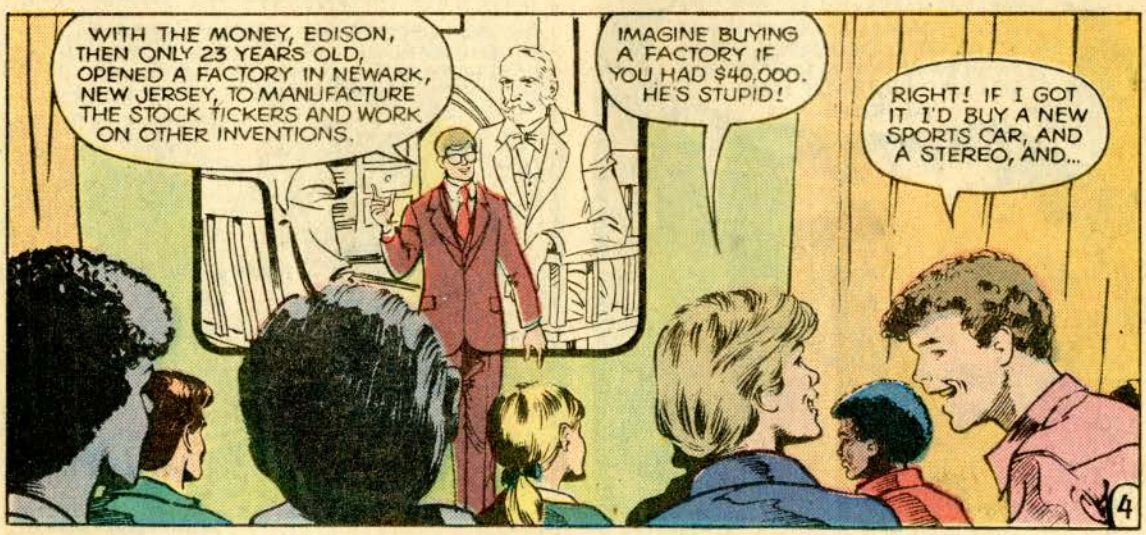
"HE GOT USED TO HARD WORK AND HARD KNOCKS EARLY IN LIFE. AT ONLY 12, EDISON WAS A CANDY 'BUTCHER'! HE SOLD CANDY, SANDWICHES, AND PAPERS TO TRAIN PASSENGERS."

"SOON AFTERWARD, EDISON SAVED THE LIFE OF A STATIONMASTER'S BABY BY SNATCHING IT OUT OF THE WAY OF AN ONCOMING TRAIN!"
Mt. Clemens
THE GRATEFUL STATION MANAGER TAUGHT HIM TELEGRAPHY.

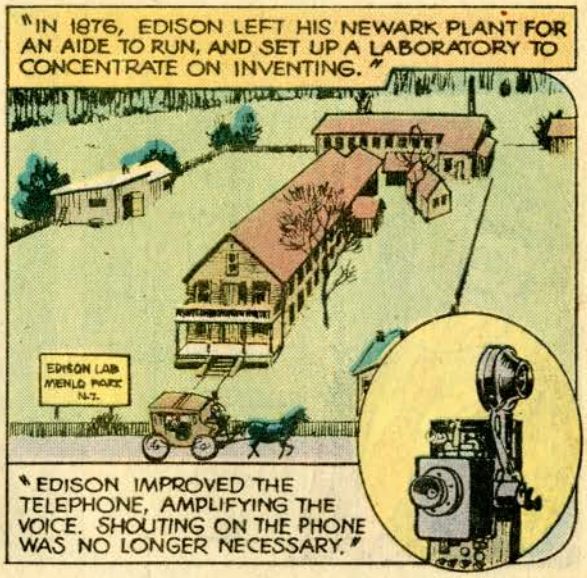
"IN HIS SPARE TIME AS A TELEGRAPHER, EDISON BEGAN HIS CAREER AS AN INVENTOR."

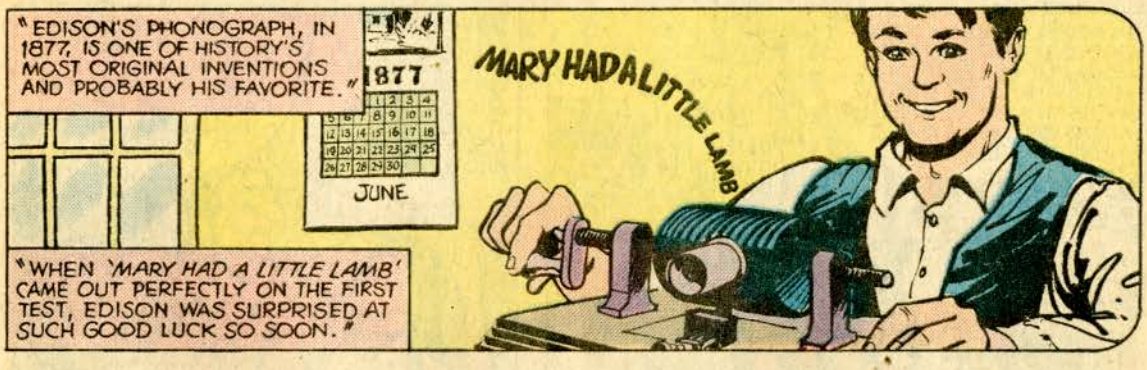
"AFTER MANY DISAPPOINTMENTS, HE PATENTED IMPROVEMENTS ON A STOCK TICKER WHICH A TELEGRAPH FIRM WANTED TO BUY."

EDISON WANTED $5,000, BUT WHEN ASKED HIS PRICE, HE SAID, "SUPPOSE YOU MAKE ME AN OFFER!" WHEN OFFERED $40,000, EDISON NEARLY FAINTED.
GOLD & STOCK TELEGRAPH Co


WITH THE MONEY, EDISON, THEN ONLY 23 YEARS OLD, OPENED A FACTORY IN NEWARK, NEW JERSEY, TO MANUFACTURE THE STOCK TICKERS AND WORK ON OTHER INVENTIONS.
IMAGINE BUYING A FACTORY IF YOU HAD $40,000. HE'S STUPID!
RIGHT! IF I GOT IT I'D BUY A NEW SPORTS CAR, AND A STEREO, AND...
4

HOWEVER, HIS MAIN INTEREST WAS INVENTING.
ONE OF HIS INVENTIONS IMPROVED THE TYPEWRITER. NOW, IT WAS POSSIBLE TO TYPE FASTER THAN WRITING IN LONGHAND.


"IN 1876, EDISON LEFT HIS NEWARK PLANT FOR AN AIDE TO RUN, AND SET UP A LABORATORY TO CONCENTRATE ON INVENTING."
EDISON LAB MENLO PARK N.J.
"EDISON IMPROVED THE TELEPHONE, AMPLIFYING THE VOICE. SHOUTING ON THE PHONE WAS NO LONGER NECESSARY."

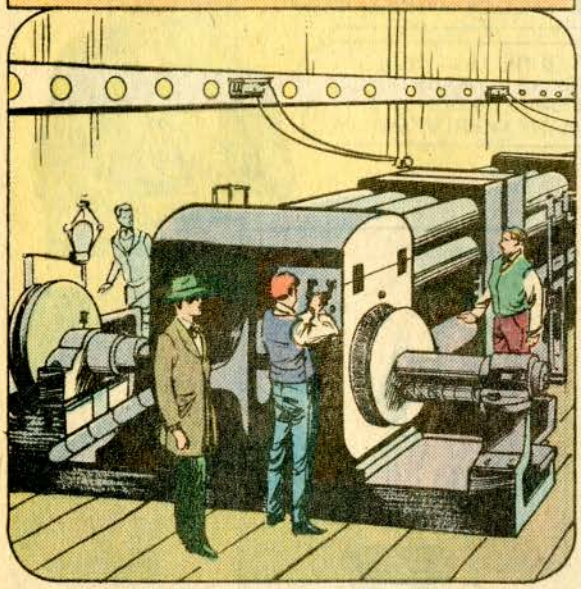

"EDISON'S PHONOGRAPH, IN 1877, IS ONE OF HISTORY'S MOST ORIGINAL INVENTIONS AND PROBABLY HIS FAVORITE."
1877
JUNE
MARY HAD A LITTLE LAMB
"WHEN 'MARY HAD A LITTLE LAMB' CAME OUT PERFECTLY ON THE FIRST TEST, EDISON WAS SURPRISED AT SUCH GOOD LUCK SO SOON."

"THEN IN 1879 CAME THE INVENTION OF THE ELECTRIC LIGHT, WHICH CHANGED THE WORLD!"
SUCCESS! BUT NOW WE MUST SUPPLY ELECTRICITY FOR PERHAPS MILLIONS OF THESE NEW LAMPS.
5

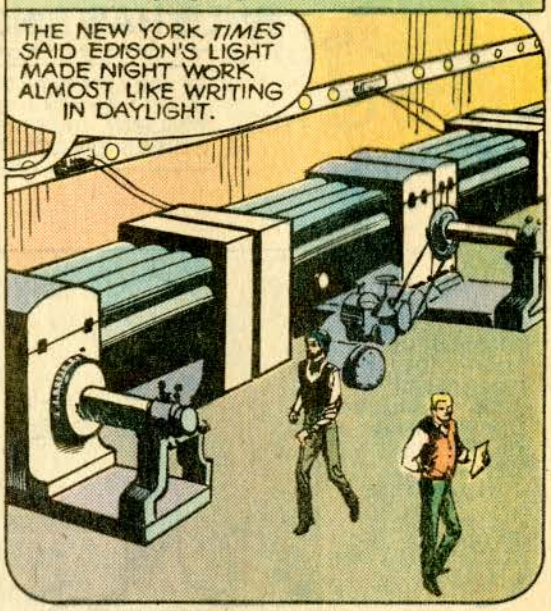
"EDISON IMMEDIATELY SET OUT TO BUILD A CENTRAL POWER STATION TO GENERATE AND DELIVER ELECTRICITY TO INDUSTRY AND HOMES."
HIS FIRST GENERATOR, INVENTED IN 1879, PRODUCED ELECTRICITY TO LIGHT ONLY A FEW LAMPS.

LITERALLY HUNDREDS OF DEVICES HAD TO BE INVENTED TO MAKE THE FIRST CENTRAL POWER STATION OPERATIONAL.
IT WAS TO BE LOCATED ON PEARL STREET TO SERVE DOWNTOWN NEW YORK WHERE THERE WERE MANY FACTORIES AND OFFICES.
PLACING CABLES UNDER-GROUND WAS ANOTHER EXAMPLE OF EDISON'S FORESIGHT. MOST UTILITY WIRES IN HEAVILY BUILT-UP AREAS SOON FOLLOWED EDISON'S EXAMPLE.
WHY AREN'T ALL THE UTILITY WIRES UNDER-GROUND? I SHOULD THINK IT WOULD LOOK BETTER AND BE SAFER.
PRIMARILY BECAUSE IT COSTS A GREAT DEAL MORE. BUT MORE UNDERGROUND CABLES ARE BEING INSTALLED WHERE IT IS FEASIBLE.
"MANY OPPOSED EDISON'S PROGRAM OF DISTRIBUTING ELECTRICITY, THINKING IT DANGEROUS."
TO PROVE THEIR POINT, ONE PROTEST GROUP ELECTROCUTED SEVERAL DOGS IN CENTRAL PARK.
ELECTRICITY IS DANGEROUS
I DIDN'T KNOW THEY HAD PROTEST GROUPS WAY BACK IN THOSE DAYS...
THEY DID, AND IF THEIR PROTEST HAD BEEN SUCCESSFUL, JUST THINK HOW IT WOULD HAVE CHANGED OUR LIVES FOR THE WORSE!
6

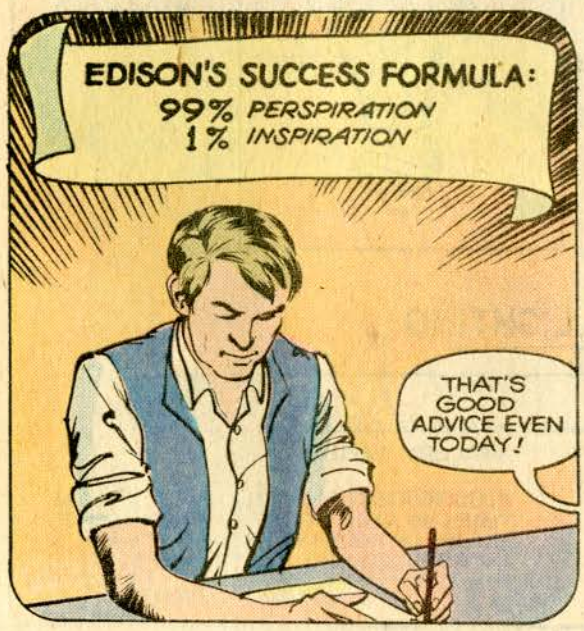
"ON SEPTEMBER 4, 1882, THE SWITCH WAS CLOSED AND OUR FIRST POWER STATION WENT INTO OPERATION. IT WAS THE FORERUNNER OF TODAY'S ELECTRIC UTILITIES."



"WHILE THERE WERE MANY START-UP PROBLEMS AND DELAYS, THEY WERE SOON OVERCOME."



BUT MR. WELDON, IT TOOK MR. EDISON A LONG TIME TO INVENT THE LIGHT BULB. HOW WAS HE ABLE TO INVENT AND BUILD A WHOLE POWER SYSTEM IN ONLY THREE YEARS?
WE ALL KNOW EDISON WAS A GREAT INVENTOR, BUT ABOVE ALL HE *WORKED HARD.* HERE'S HOW HE PUT IT:



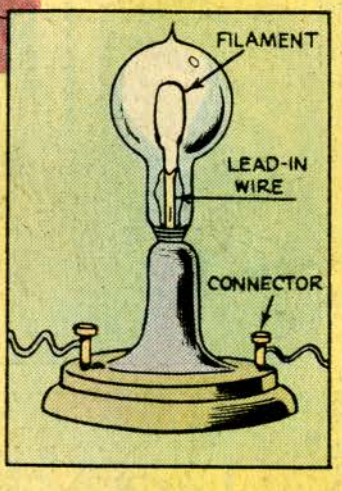
"THANKS TO EDISON, THE WORLD WAS GIVEN NOT ONLY THE INCANDESCENT LIGHT BULB BUT ALSO EFFICIENT SYSTEMS TO SUPPLY THE ENERGY THEY REQUIRED."

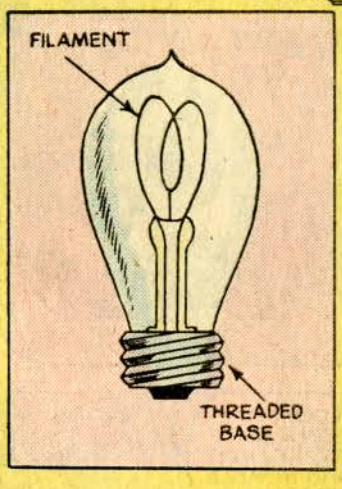
"BY 1902, ONLY 20 YEARS AFTER EDISON'S ELECTRIC SYSTEM BEGAN OPERATIONS, THERE WERE 3,500 DIFFERENT ELECTRIC SYSTEMS IN THE U.S. ALONE."

HOW EDISON'S ORIGINAL LIGHT BULB HAS SINCE BEEN IMPROVED

AFTER EDISON INVENTED THE LIGHT BULB, HE KEPT RIGHT ON WORKING TO MAKE IT MORE EFFICIENT. OVER THE YEARS, EDISON AND OTHERS EFFECTED MANY IMPROVEMENTS.

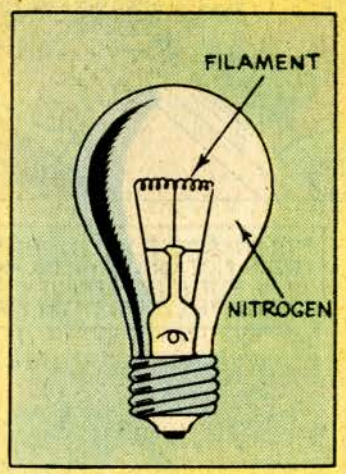
EDISON'S FIRST SUCCESSFUL BULB HAD A CARBON FILAMENT IN A VACUUM WITHIN A GLASS BULB. LEAD-IN WIRES LED FROM THE FILAMENT TO BRASS CONNECTORS ON A WOODEN BASE.

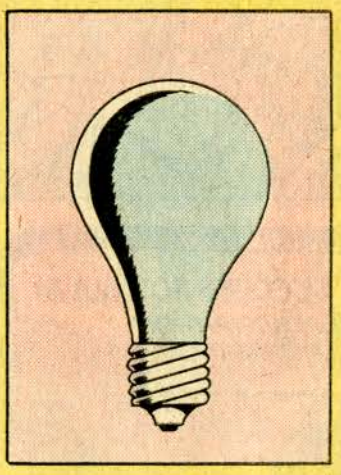




EDISON SOON REPLACED THE AWKWARD WOODEN BASE AND CONNECTORS WITH A METAL THREADED BASE THAT WOULD FIT INTO BRASS SOCKETS.

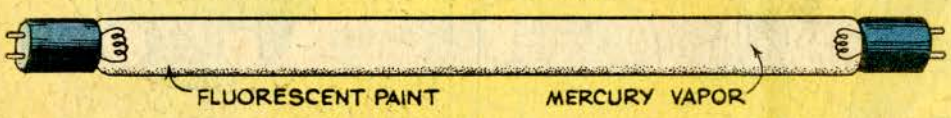
TIGHTLY COILED TUNGSTEN METAL FILAMENTS IN NITROGEN-FILLED BULBS FIRST APPEARED IN 1911. THEY GAVE MORE LIGHT AND LASTED LONGER.





MOST MODERN LIGHT BULBS HAVE FROSTED GLASS WHICH MINIMIZES THE GLARE. THEY WERE INTRODUCED IN 1925.

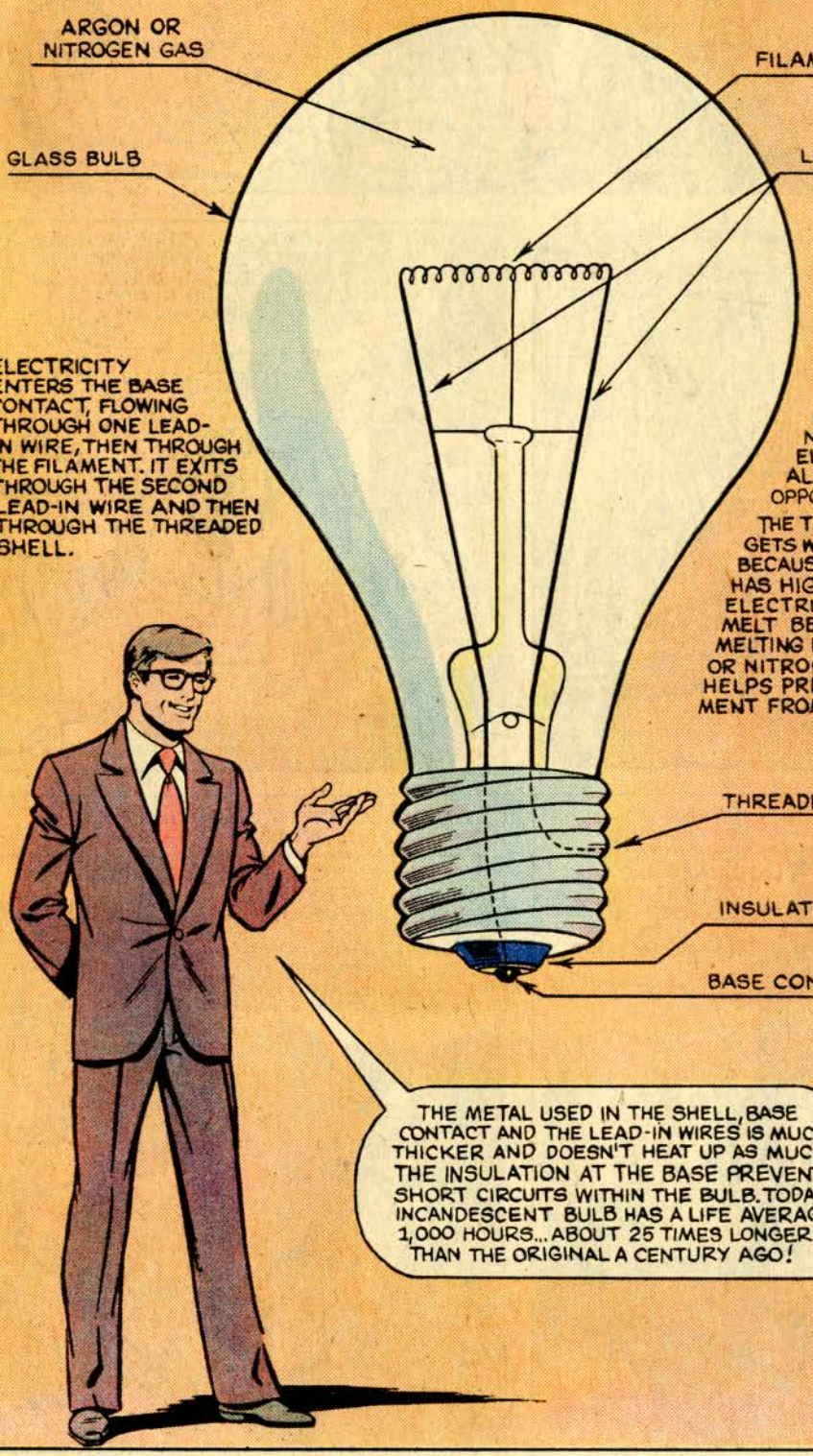
FLUORESCENT LIGHTING

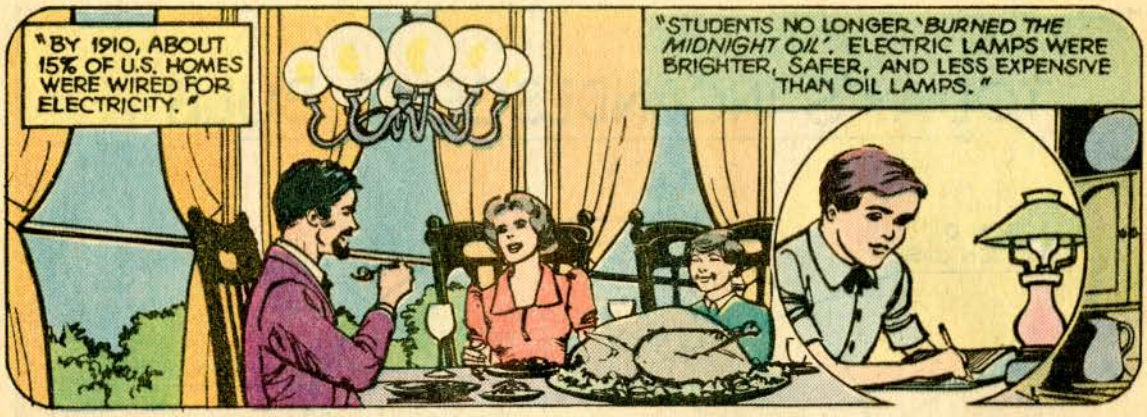


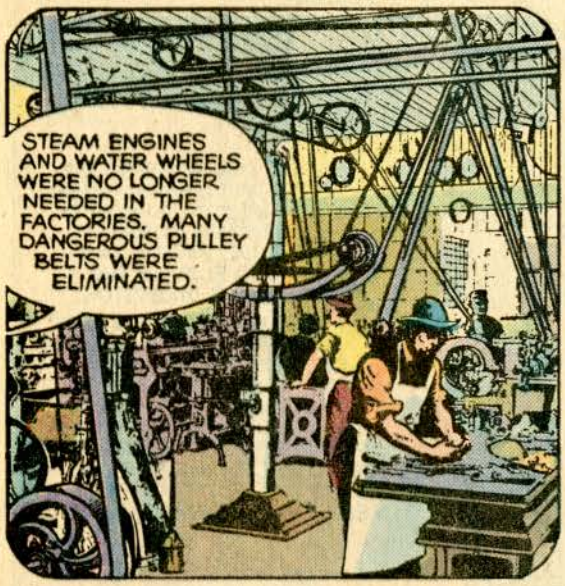
ELECTRICITY FLOWS THROUGH MERCURY VAPOR, PRODUCING ULTRA-VIOLET LIGHT. A FLUORESCENT COATING INSIDE THE TUBE CONVERTS THE ULTRA-VIOLET TO VISIBLE LIGHT.

FLUORESCENT LIGHTING GIVES SEVERAL TIMES AS MUCH LIGHT AS INCANDESCENT BULBS OF THE SAME WATTAGE. IT WAS INTRODUCED IN THE LATE 1930'S.

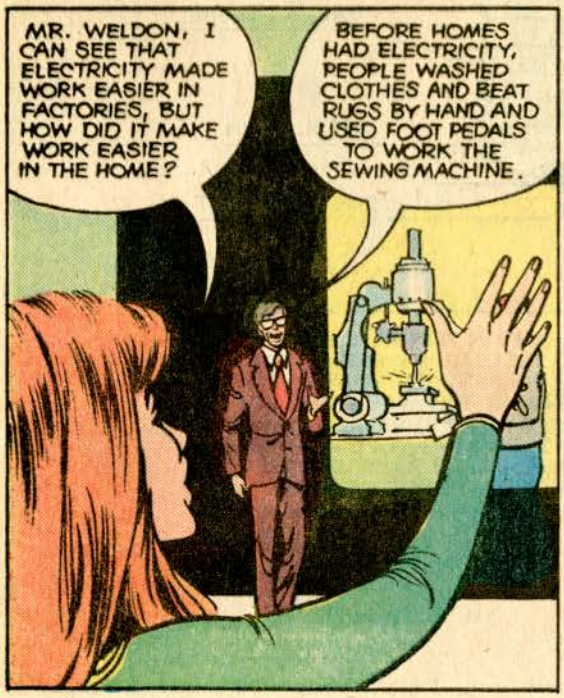
TODAY'S INCANDESCENT BULB


ARGON OR NITROGEN GAS
FILAMENT
GLASS BULB
LEAD-IN WIRES
ELECTRICITY ENTERS THE BASE CONTACT, FLOWING THROUGH ONE LEAD-IN WIRE, THEN THROUGH THE FILAMENT. IT EXITS THROUGH THE SECOND LEAD-IN WIRE AND THEN THROUGH THE THREADED SHELL.
SINCE THE BULBS ARE USUALLY CONNECTED TO ALTERNATING CURRENT, ELECTRICITY CAN ALSO FLOW IN THE OPPOSITE DIRECTION.
THE TUNGSTEN FILAMENT GETS WHITE HOT AND GLOWS BECAUSE ITS THIN METAL HAS HIGH RESISTANCE TO ELECTRICITY. IT DOESN'T MELT BECAUSE OF ITS HIGH MELTING POINT. THE ARGON OR NITROGEN IN THE BULB HELPS PREVENT THE FILAMENT FROM BURNING OUT.
THREADED SHELL
INSULATION
BASE CONTACT
THE METAL USED IN THE SHELL, BASE CONTACT AND THE LEAD-IN WIRES IS MUCH THICKER AND DOESN'T HEAT UP AS MUCH. THE INSULATION AT THE BASE PREVENTS SHORT CIRCUITS WITHIN THE BULB. TODAY'S INCANDESCENT BULB HAS A LIFE AVERAGING 1,000 HOURS... ABOUT 25 TIMES LONGER THAN THE ORIGINAL A CENTURY AGO!


"BY 1910, ABOUT 15% OF U.S. HOMES WERE WIRED FOR ELECTRICITY."
"STUDENTS NO LONGER 'BURNED THE MIDNIGHT OIL'. ELECTRIC LAMPS WERE BRIGHTER, SAFER, AND LESS EXPENSIVE THAN OIL LAMPS."


STEAM ENGINES AND WATER WHEELS WERE NO LONGER NEEDED IN THE FACTORIES. MANY DANGEROUS PULLEY BELTS WERE ELIMINATED.

INSTEAD, SMALL ELECTRIC MOTORS, MANY DEVELOPED BY EDISON HIMSELF, INCREASED SAFETY, PRODUCTIVITY, AND REDUCED COSTS TO THE CONSUMER.


MR. WELDON, I CAN SEE THAT ELECTRICITY MADE WORK EASIER IN FACTORIES, BUT HOW DID IT MAKE WORK EASIER IN THE HOME?
BEFORE HOMES HAD ELECTRICITY, PEOPLE WASHED CLOTHES AND BEAT RUGS BY HAND AND USED FOOT PEDALS TO WORK THE SEWING MACHINE.

"WITH ELECTRICITY, SMALL MOTORS DID THE WORK."
ELECTRIC SEWING MACHINES CAME ALONG ABOUT 1900. VACUUM CLEANERS AND WASHING MACHINES WERE AVAILABLE SHORTLY AFTER.

"ELECTRIC STREETCARS BEGAN TO REPLACE THE HORSE AND BUGGY."

1888 SAW THE FIRST ELECTRIC RAILWAY, IN RICHMOND, VIRGINIA. BY 1900, THERE WERE OVER 22,000 MILES OF TROLLEY-CAR TRACKS IN U.S. CITIES.

"IN 1895, THE FIRST ELECTRIC RAILROAD TRAIN WENT INTO SERVICE."

ELECTRIC TRAINS WERE CLEANER AND QUIETER. BOTH PASSENGERS AND CITIES BENEFITED BECAUSE TRAINS DIDN'T EMIT SMOKE.

"ELECTRICITY MADE OFFICE WORK MORE EFFICIENT. EDISON'S DICTATING MACHINE CAME IN 1889, ADDING MACHINES SHORTLY AFTER."

TODAY, OF COURSE, ELECTRICITY POWERS TYPEWRITERS, COMPUTERS, PRACTICALLY EVERYTHING, EVEN PENCIL SHARPENERS.

"EDISON INVENTED THE MOTION PICTURE CAMERA ALSO IN 1889. BY THE 1920'S THERE WERE 15,000 U.S. MOVIE THEATRES, THANKS TO ELECTRICITY'S WIDE DISTRIBUTION."

ELECTRICITY TO MAKE MOVIES EACH YEAR WOULD SUPPLY THE NEEDS OF A TOWN OF 5,000.

THE KID

CHARLIE CHAPL

RADIO WAS THE FAVORITE HOME ENTERTAINMENT OF MILLIONS BEGINNING IN THE LATE 1920'S. ELECTRICITY POWERED THE RADIO STATIONS AND THE RADIOS IN HOMES.

RUDY VALLEE

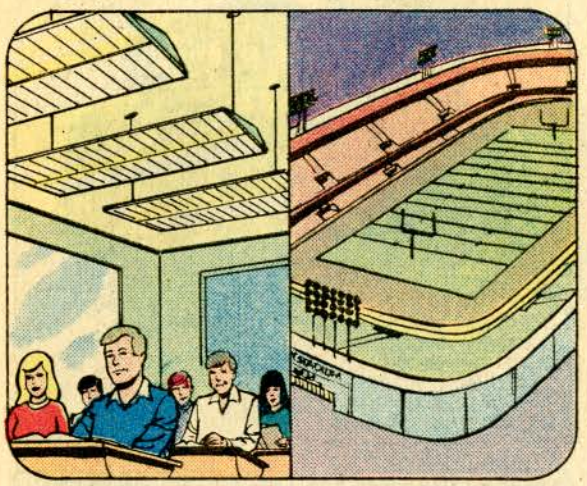
EDGAR BERGEN

JACK BENNY

KATE SMITH

"TV SWEPT THE COUNTRY IN THE 1950'S. AGAIN, AS WITH RADIO, ELECTRICITY MADE ITS TRANSMISSION AND RECEPTION POSSIBLE."

"IMPROVED LIGHTING MADE NIGHT SPORTS POSSIBLE, AND MODERN STREET LIGHTS IMPROVED SAFETY AT NIGHT. IN SCHOOLS DARK DAYS BECAME BRIGHT."



"AND THROUGH THE YEARS THE COST OF ELECTRICITY WENT DOWN."

AS YOU SEE, IN 1885, ONE HOUR'S WAGES WOULD BUY 3/4 OF A KILOWATT HOUR (KWH) BUT IN 1935 IT BOUGHT 10 3/4 KWH -- OVER 14 TIMES AS MUCH...

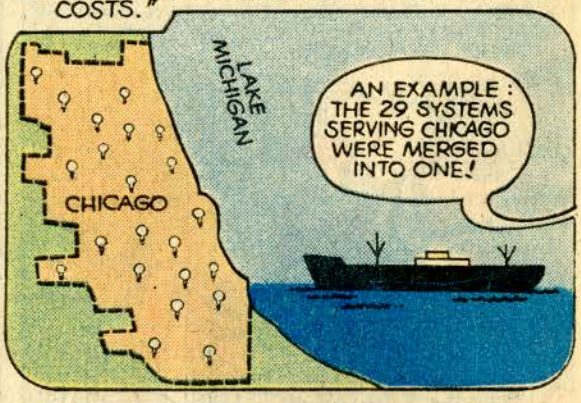
HOW MUCH ELECTRICITY ONE HOUR'S WAGES BOUGHT

1885 1935

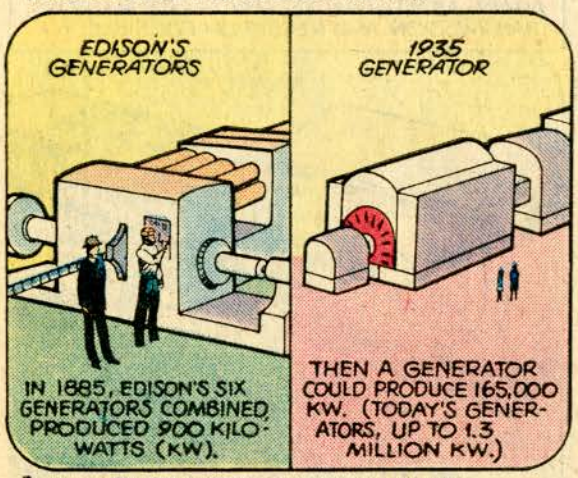
3/4 KWH 10 3/4 KWH

1 KILOWATT HOUR (KWH) = 100 WATT BULB BURNING 10 HOURS

"FIRST, MANY POWER SYSTEMS MERGED, ELIMINATING COSTLY DUPLICATION. IT WAS THEN POSSIBLE TO USE LARGER, MORE COST-EFFICIENT EQUIPMENT, FURTHER REDUCING COSTS."

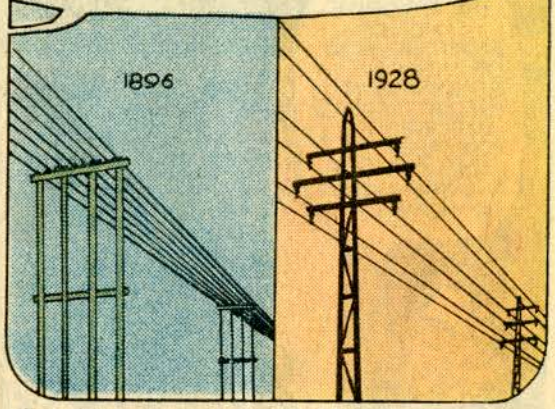


"...THE INCREASED VOLUME AS MORE PEOPLE USED MORE ELECTRICITY..."


EDISON'S GENERATORS
1935 GENERATOR
IN 1885, EDISON'S SIX GENERATORS COMBINED, PRODUCED 900 KILOWATTS (KW).
THEN A GENERATOR COULD PRODUCE 165,000 KW. (TODAY'S GENERATORS, UP TO 1.3 MILLION KW.)

"...PLUS ENGINEERING IMPROVEMENTS, ENABLED LARGER, MORE EFFICIENT GENERATORS TO CUT COSTS EVEN MORE."

AND IMPROVED TRANSMISSION SYSTEMS DELIVERED MORE ELECTRICITY GREATER DISTANCES, AGAIN CUTTING COSTS.



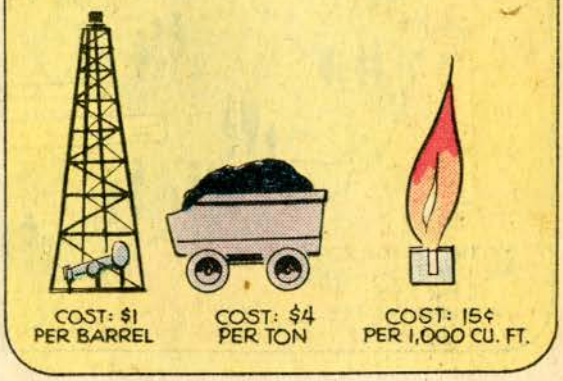
"IN 1896, 10,000 KW TRAVELED 20 MILES -- NIAGARA FALLS TO BUFFALO. IN 1928, 240,000 KW WERE DELIVERED 266 MILES. TODAY 1.3 MILLION KW TRAVEL 1,500 MILES.

"BUT MERGERS ALSO CREATE MONOPOLIES WHERE ONLY ONE UTILITY SERVES A GIVEN AREA."

TO INSURE FAIR RATES TO CONSUMERS AND FAIR RETURNS TO INVESTORS, STATE REGULATORY COMMISSIONS WERE ESTABLISHED AS EARLY AS 1907.

"IN THE 1930'S, FUELS WERE INEXPENSIVE AND ABUNDANT."

COAL FUELED 56% OF THE ELECTRICITY, OIL 3%, NATURAL GAS 7%. HYDRO-POWER SUPPLIED THE BALANCE.



COST: $1 PER BARREL

COST: $4 PER TON

COST: 15¢ PER 1,000 CU. FT.

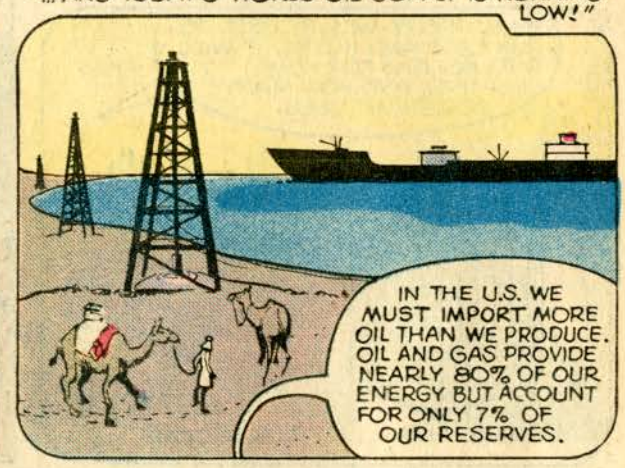
"THE FIRST NUCLEAR PLANT CAME IN 1957, AND WITH IT A NEW FUEL -- URANIUM!"

VERY IMPORTANT, SINCE OUR RESERVES OF OIL AND GAS WERE GETTING LOW!

AT ABOUT THE SAME TIME, WE BEGAN TO IMPORT OIL...

"... AND TODAY'S WORLD OIL SUPPLY IS RUNNING LOW!"

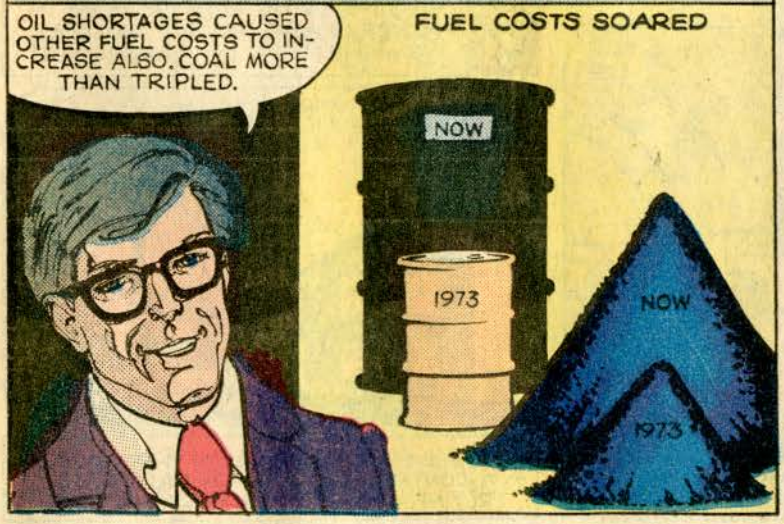
IN THE U.S. WE MUST IMPORT MORE OIL THAN WE PRODUCE. OIL AND GAS PROVIDE NEARLY 80% OF OUR ENERGY BUT ACCOUNT FOR ONLY 7% OF OUR RESERVES.



"IN THE 1970'S, THE COST OF IMPORTED OIL WAS SOARING. NOW IT'S OVER 12 TIMES MORE THAN IN 1973 -- AND IS STILL RISING."

OIL SHORTAGES CAUSED OTHER FUEL COSTS TO INCREASE ALSO. COAL MORE THAN TRIPLED.

FUEL COSTS SOARED



AND BY THE NEW CENTURY, ELECTRIC UTILITIES MUST MORE THAN DOUBLE THEIR CURRENT OUTPUT, REQUIRING VAST AND COSTLY EXPANSIONS OF GENERATING AND TRANSMISSION FACILITIES.

"BY THE YEAR 2000, THE U.S. POPULATION WILL BE 265 MILLION PEOPLE."

"IN THE NEXT TEN YEARS ALONE, WE'LL NEED ADDITIONAL ELECTRICITY FOR THE ONE MILLION NEW JOBS THAT WILL BE ADDED TO THE ECONOMY EACH YEAR TO MAINTAIN OUR PRESENT STANDARD OF LIVING."

"WE MUST SUBSTITUTE ELECTRICITY FOR OIL AND GAS WHENEVER IT IS POSSIBLE."

ELECTRICITY WILL BE USED TO RUN CARS AND BUSES. IT WILL REPLACE GAS FOR HOME HEATING, AND FOR MANY INDUSTRIAL USES.

HEAT PUMP

ELECTRIC CAR

BUT WE CAN'T REPLACE PETROLEUM IN THE MANUFACTURING OF MANY PRODUCTS LIKE ORLON, SYNTHETIC RUBBER, AND PLASTIC. IT MUST BE USED FOR THIS PURPOSE SO WE MUST SAVE ENOUGH.

HOSE

PAINT

SYNTHETIC DRESS

"OUR ONLY PLENTIFUL FUELS UNTIL THE NEW CENTURY ARE COAL, AND URANIUM FOR NUCLEAR POWER."

"THE OTHER SOURCES OF ENERGY, LIKE FUSION, SOLAR, THE OCEAN WON'T PRODUCE SIGNIFICANT ENERGY UNTIL THE YEAR 2000 AND AFTER."

"SO TO INCREASE ELECTRICITY PRODUCTION, WE MUST USE MORE COAL AND URANIUM FOR THE NEXT 20 YEARS."

"TODAY, SEVERAL HUNDRED ELECTRIC UTILITY RESEARCH PROJECTS ARE SPEEDING UP THE ROLE OF SOLAR POWER IN HOME HEATING AND COOLING, AND IN ELECTRICITY GENERATION."

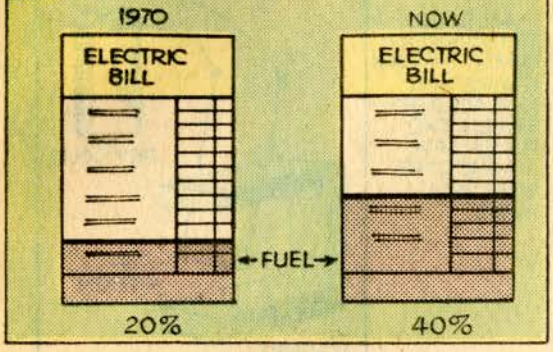
SOLAR HEATING AND COOLING

CENTRAL RECEIVING SOLAR SYSTEM

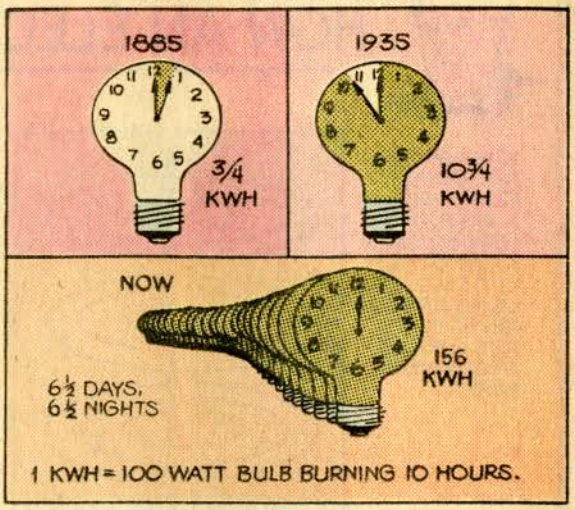
"RELIABLE ESTIMATES INDICATE THAT SOLAR MAY CONTRIBUTE 5% OR MORE TO OUR ENERGY NEEDS BY THE NEW CENTURY."

"INFLATION HAS INCREASED ALL UTILITY COSTS. BUT THE SOARING COSTS OF FUELS HAVE INCREASED ELECTRIC BILLS EVEN MORE."

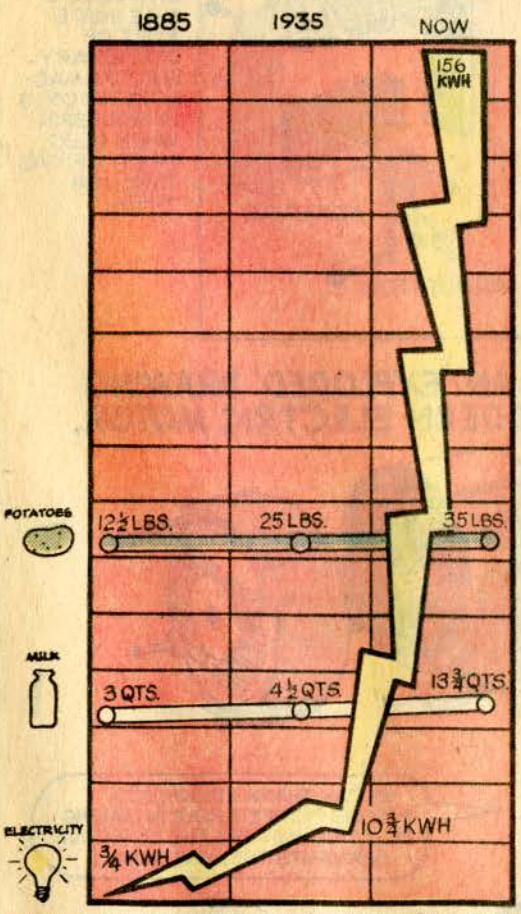
IN 1970, FUEL ACCOUNTED FOR 20% OF THE AVERAGE ELECTRIC BILL. NOW, IT'S 40%--DOUBLING ITS PROPORTION.



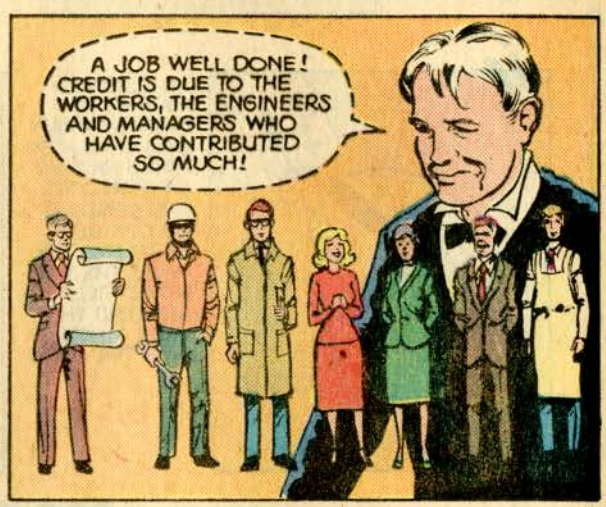
"BUT EVEN SO, WE NOW GET MORE THAN 200 *TIMES* MORE ELECTRICITY FOR ONE HOUR'S WAGES THAN IN 1885!"

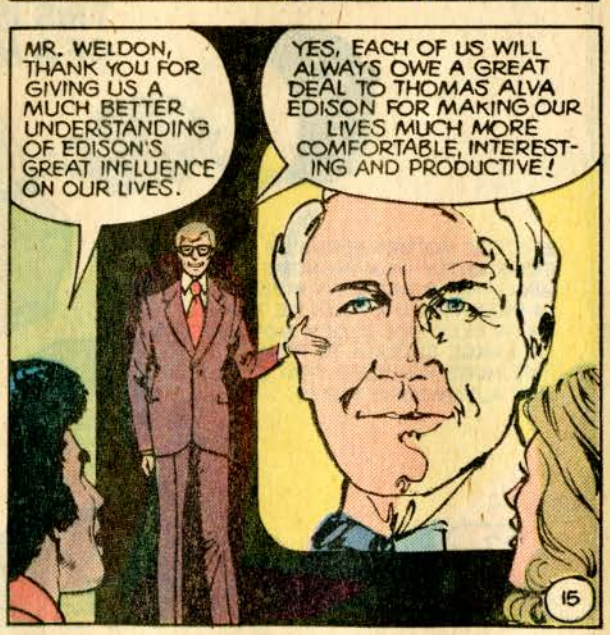


COST COMPARISON
WITH EVERY DAY STAPLES
WHAT ONE HOUR'S WAGES WOULD BUY



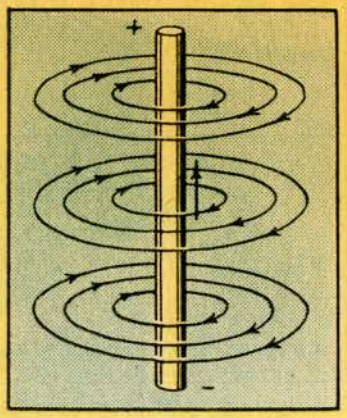
NOW, ONE HOUR'S WAGES BUYS 2¾ TIMES MORE POTATOES THAN IN 1885, 4½ TIMES MORE MILK, BUT *OVER 200 TIMES MORE ELECTRICITY!*



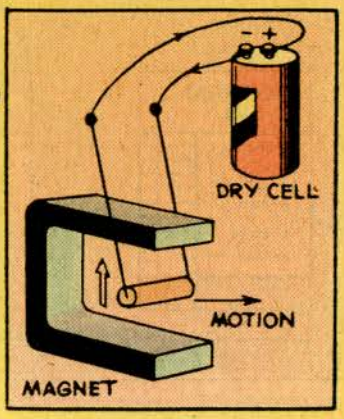

MR. WELDON, THANK YOU FOR GIVING US A MUCH BETTER UNDERSTANDING OF EDISON'S GREAT INFLUENCE ON OUR LIVES.
YES, EACH OF US WILL ALWAYS OWE A GREAT DEAL TO THOMAS ALVA EDISON FOR MAKING OUR LIVES MUCH MORE COMFORTABLE, INTERESTING AND PRODUCTIVE!

HOW AN ELECTRIC MOTOR WORKS

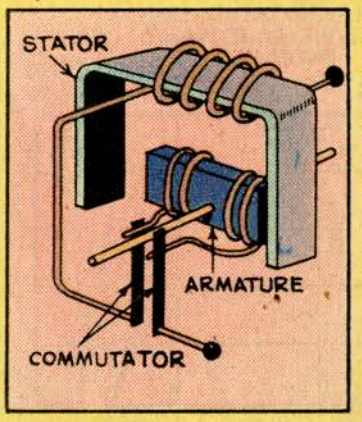
WHEN AN ELECTRIC CURRENT FLOWS THROUGH A WIRE, THE WIRE BECOMES A KIND OF MAGNET. CIRCULAR LINES OF MAGNETIC FORCE ARE FORMED AROUND THE WIRE.



IF AN ELECTRIC CURRENT IS SENT THROUGH A WIRE THAT IS PLACED BETWEEN THE POLES OF A MAGNET, THE WIRE WILL MOVE.

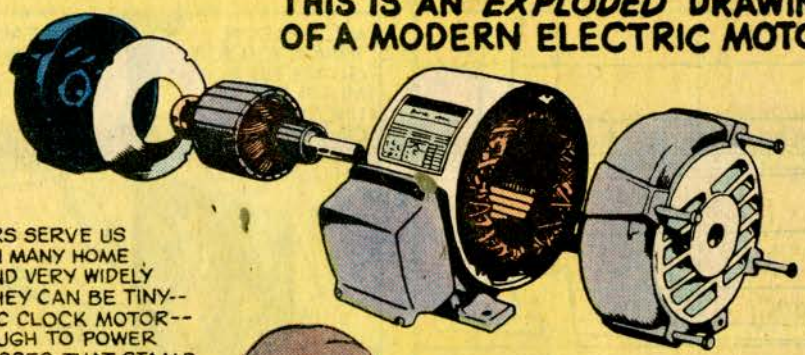


AN ELECTRO-MAGNET IS MADE BY WRAPPING INSULATED WIRES AROUND AN IRON CORE AND SENDING ELECTRICITY THROUGH THE WIRE. THE MAGNETIC FIELD AROUND THE WIRE MAGNETIZES THE CORE.



AN ELECTRIC MOTOR IS MADE WITH COILS OF WIRE INSIDE A SET OF STATIONARY ELECTROMAGNETS. THE COILS OF WIRE SPIN WHEN ELECTRICITY FLOWS THROUGH THEM.

THIS IS AN *"EXPLODED"* DRAWING OF A MODERN ELECTRIC MOTOR.



ELECTRIC MOTORS SERVE US CONSTANTLY--IN MANY HOME APPLIANCES AND VERY WIDELY IN INDUSTRY. THEY CAN BE TINY--AS AN ELECTRIC CLOCK MOTOR--OR LARGE ENOUGH TO POWER THE HUGE PRESSES THAT STAMP OUT AUTOMOBILE PARTS.